CHALLENGES TO THE DESIGN OF NEW DETECTION DEVICES

María José Espona
Presidency of the Republic, Argentina

ABSTRACT

Like in a DNA double helix, the progress in the capacity to design detection devices runs parallel with the advances in the creation of genetically modified microorganisms. The links of these two spirals is constituted by the extensive and freely available information on the new detectors development and research and experimentation with microorganisms.

In a near future, this phenomenon could lead to a race between detection devices designers and proliferators or terrorist groups that may access to the information and technology required to counter them.

This paper highlights the relevance of protecting critical know-how and intangible technology in order to deter or limit the capacity of proliferators in the biological arena.

INTRODUCTION

This paper is focused on the current and future situation in the design of new detection devices and to what extent freely available information may affect their development.

This study was performed by analyzing open sources of information.

WHAT DOES DETECTION MEAN?

Before dealing with the specific issues of this paper, it is convenient to define what the word "detect" means in this context: to identify the presence of uncommon pathogenic microorganisms, whether by quantity or space/time location, that may be harmful to health conditions in human beings, animals or crops.

In order to identify an anomaly in the system, that in this case would mean identifying the presence of a biological agent, we may follow basically two paths: to know thoroughly the characteristics of the environment (where the detection will be performed) or the biological warfare agents (BW agent).

Considering these two aspects, the detection of BW agents represents a great challenge, since it is almost impossible to know and characterize every possible environment, as well as to distinguish every potential BW agent (it is even a greater challenge when considering that they can be genetically modified).

PROGRESS IN SCIENCE AND TECHNOLOGY VS. DEVELOPMENT OF ENHANCED BW

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **01 JUL 2003**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**
4. TITLE AND SUBTITLE **Challenges To The Design Of New Detection Devices**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Presidency of the Republic, Argentina**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release, distribution unlimited**		
13. SUPPLEMENTARY NOTES **See also ADM001523.**		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**5**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

ARSENALS

In the last years, biological sciences in general -such as genetic engineering and biotechnology- and the study of microorganisms in particular -microbiology- underwent a significant growth.

What do these scientific disciplines, the design of detection devices and the development of biological weapons have in common? Information and know-how.

We have to bear always in mind that the information we are referring to is mostly public and freely available in scientific and industrial sectors, principally in pharmaceutics.

The control of these two sectors is particularly complex: the academic sector is closely related to the advance of science and, through its application, it saves thousands of lives. Therefore, controlling the academic sector could result in worse health care conditions and a lower population growth rate (availability of food, access to low-cost health care centers, access to drinking water resources, treatment of illnesses, etc.).

As regards the industrial sector, it must be noted that there is a significant degree of self-control in order to protect the industrial secret and the investment made to develop a product. Yet, very often the methodology used to develop a product or the principles on which it was developed are revealed when offering the product.

The protection of information is particularly important when dealing with the development of detection systems: if the principles on which these systems were based to operate are revealed, the information about how to harm them is implicitly revealed as well.

On the other hand, historically when referring to BW agents they included natural microorganisms and maybe a specially selected pathogen strain, as an advanced development. Nevertheless, currently the progress of genetic engineering and biotechnology extend the possibility of producing customized BW agents.

Should we divide potential biological agents in groups, they would be:

1. Known natural microorganisms;

2. Genetically modified microorganisms in order to:
    a. avoid their identification;
    b. provide them with characteristics they lacked (for instance, a flu virus with the genes of a haemorrhagic fever, causing a new type of illness, such as an “haemorrhagic flu”),

3. New agents (for instance, those that have not been discovered yet because they remain in a virgin rainforest without having contact with human populations).

In the cases 1 and 2b, the detectors can be programmed in order to identify the BW agents. But for 2a it is necessary to look for another way of determining if there is any microorganism that has the potential to cause damage.

The situation in case 3 is similar to case 2a, with the exception that if case 2a involves a microorganism modified not to be detected, once identified it is possible to develop a cure, vaccine or treatment. Yet, in case 3, many trials might be necessary until the correct countermeasure is found, which require a lot of valuable time.

As regards what kind of know-how to protect, the information on applied methods is very often more sensitive than the data that refers to specific cases. For instance, the method to make genetically modified microorganisms is not new: it is at least 10 years old and it is virtually impossible to revise all the methods revealed in magazines, books, scientific exchanges, joint projects, symposia and conferences.

DETECTION DEVICES

By and large, working to enhance detection and protection systems comes as a response to the perception of growth and/or upgrade of the enemy arsenal. These activities are similar in both sides of the equation, thus generating a defensive and offensive armament race.

In the case of biological weapons, the situation is more complex: in a first stage, biological weapons and means of protection were developed, leaving detection aside. Later and with the increasing biological threat posed by non-state actors, relevance was given to the production of detection devices capable of providing early warning and identifying in real time the presence of BW agents.

In fact, it may be asserted that it is only now that we are very close to achieving a mobile real-time detection system.

In a near future, the problem that the developers of detection devices must face will be the great availability of information for the development of genetically modified biological agents, in particular those altered to avoid their detection.

MUST CRITICAL INFORMATION BE PROTECTED?

The current challenge in the field of non-proliferation is to control the flow of information without affecting the progress of science and medicine and at the same time avoiding that this critical information might be acquired by groups or countries with the intention of developing biological weapons - even if it is not in the near future.

The protection of information is not new to the scientific community. A recent widely-known reference is what occurred during the Cold War when the Government of the United States tried to constrain information exchange in some areas of mathematics and the physical sciences that might have aided Soviet nuclear weapons development. But, even at the height of the Cold War, the National Academy of Sciences (NAS) concluded that a higher security level would be achieved by open pursuit of scientific knowledge than by curtailing free exchange of scientific information.

In this context, the American Society of Microbiology has adopted policies and specific procedures for its publications, so that the developments that are of national security concern, particularly those dealing with select agents, be modified in such manner to avoid the transmission of relevant know-how on the production of WMD. The negative side is that it affects the dynamic of the progress of science, since it is almost impossible to prove the results published by other scientists because not all the information is known.

But on the other hand, other institutions like the MIT reject classified research because it conflicts with their educational missions.

Another issue is to whom not to give access to the information. First, the “bad boys” come up - countries comprising the Axis of Evil, countries suspected of developing WMD programs, individuals or organizations who may be linked to terrorist groups, et alia. Thus, the number of countries of proliferation concern may rise from 3 to dozens as well as the number of entities to control.

Thus, the long-standing tension between openness in science and the protection of national security, continues.

The wars against terrorism and infectious diseases are global. If governments move towards restraining the flow of information across national boundaries, there will be an inevitable clash with the academic research community that is increasingly seeking international collaborations and partnerships.

Limiting information exchange could slow the discovery of vaccines and drugs to treat infectious diseases, including those needed to defend the population against bioterrorism.

In the case of information control, the result would not be valid if it is performed by one country only, even if that it were the United States, since life sciences are in an advanced level in many places around the world. It is important to bear in mind that it is a global problem in the globalization era. Currently, security is presented as the clash between good and evil: developments for the progress of science, medicine and defense vs. development of increasingly effective BW agents that may break the defenses.

CONCLUSIONS

Governments and professional organizations must proceed jointly in avoiding widespreading potentially useful information for the development of BW agents. It is worthless that a state or an organization alone takes measures to avoid the diffusion of critical information. The control over know-how transfers must be done through a multilateral consensus approach, without curtailing any individual freedom nor originating any xenophobic behavior.

In this framework, the strengthening of the Biological Weapons Convention gains great importance as a forum where the criteria for the transfer of materials and information could be agreed.

Balancing openness of scientific communication with classification, sensitive homeland security information and national security will be an issue difficult to solve. In this context, the scientific community may take the lead to develop self-policing procedures that protect national security and permit the advancement of science needed for the protection of public health.

In the case of detection devices in particular, should the information on BW detection devices technology or the identification phases be published, the system may become vulnerable: if an enemy knew that soldiers from certain country carried a determined detection device, the enemy would use other agents (that the device cannot detect) or different means to infect the soldiers.

It is extremely important to acknowledge the value of the information to be transmitted and to be aware of its possible misuse.

ACKNOWLEDGMENT

To Peter Stopa for his invitation to participate in this Conference and to the NATO to support me in the financials aspects.

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